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Automatic Image Enhancement for Better Visualization using Retinex Technique

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Abstract- Image processing is a method to convert an image into a digital form and perform some operations on it, in order to et an enhanced image or to extract some useful information from it. Image enhancement uses no of techniques or improving the visual quality of the image. Retinex image enhancement is an technique which enhances the quality of the image by using histogram generation technique.

Index Terms- Image processing, image enhancement, histogram modeling, retinex image enhancement technique.

I. Introduction

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph, and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image processing basically includes three steps, 1) importing the image with optical scanner or by digital photography 2) analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs. 3) output is the last stage in which result can be altered image or report that is based on image analysis. Image enhancement refers to accentuation or sharpening of image features such as boundaries, edges or contrast to make a graphic display more useful for display and analysis. The enhancement process does not increase the inherent information content in the data but it does increase the dynamic range of the chosen features so that they can be easily detected. Image enhancement includes gray level and contrast manipulation, noise reduction, edge crispening and sharpening, filtering and so on. The main difficulty in image enhancement is quantifying the criteria for enhancement. Hence large no of image enhancement techniques are empirical and require interactive procedures to obtain proper results. Numerous enhancement techniques have been introduced and these can be divided into three groups as 1) techniques that decompose an image into high and low-frequency signals for manipulation 2) transform-based-techniques 3) histogram modification techniques [1].

First two techniques use multi-scale analysis to decompose the image into different frequency bands and enhance its desired global and local frequencies. These techniques are computationally complex. Hence, histogram modification techniques received the most attention due to their straightforward and intuitive implementation techniques.

II. Proposed System

2.1 System Architecture:

As shown in fig. 1, our proposed system is useful in improving the visual quality of different types of images. This system generally divides into five parts. It first takes an image as an input. Then we applied modeling techniques on these images. For modeling purpose we have suggested a Retinex image enhancement technique. After applying the technique on modeling we suggested partitioning and mapping of an image which are useful for enhancing an image quality. After mapping the proposed technique is utilized to extend the original image to a color image so that its features can be extracted easily.

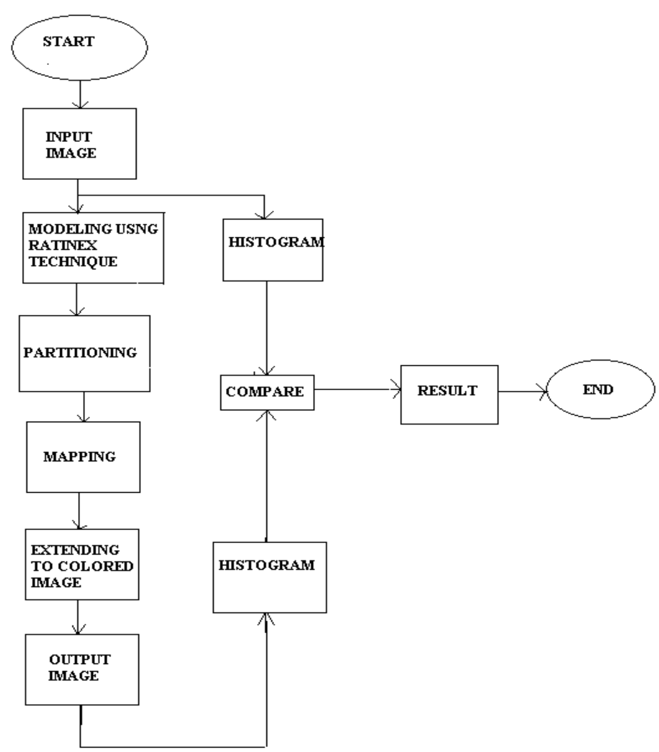

Fig 1: System work flow

The proposed work can be categorized into following modules:

Module 1: Histogram generation for input image:

Histogram modeling:

The histogram of an image represents the relative frequency of occurrence of the various gray levels in the image. Histogram-modeling techniques modify an image so that its histogram has desired shape. This is useful in stretching the low-contrast levels of image with narrow histograms. Among these techniques Linear contrast stretching (LCS) and global histograms equalization (GHE) are widely used for global image enhancement.LCS adjusts the dynamic range of an image and GHE uses an input to output mapping obtained from the cumulative distribution function(CDF).

Since contrast gain is proportional to height of histograms, gray levels with large pixel populations are expanded to a larger range of gray levels. But GHE and LCS are having some drawbacks like they do not always produce good results particularly for image with large spatial variations in contrast also GHE has undesired effect of more attentions any noise in an image. Hence Local histograms equalization (LHE) is used.

LHE methods uses a small window that slides through every image pixel sequentially and only pixels within current position of the window are histograms equalized.

Optimization technique is also employed for contrast enhancement. In this method target histogram is brightness preserving histogram equalization with maximum entropy. But all these methods create problems when enhancing a sequence of images, when the histogram has spikes or when a natural looking enhanced image is required.

Module 2: Modeling using retinex technique:

Retinex Image enhancement algorithm:

Depending on the circumstances, Retinex could achieve Sharpening (Compensation for the blurring introduced by image formation process), Color constancy processing (Improve consistency of output as illumination changes) and dynamic range compression [2].

a. Single-scale retinex (SSR)

The Single-scale retinex is given by

$$R_i(x,y) = \log I_i(x,y) - \log[F(x,y) * I_i(x,y)] \quad (1)$$

Where Ii(x,y) is image distribution in the ith color band, F(x,y) is the normalized surround function.

$$\iint F(x,y)\,dx\,dy = 1 \quad (2)$$

The image distribution is the product of scenes reflectance and illumination.

$$I_i(x,y) = S_i(x,y) r_i(x,y) \quad (3)$$

Where Si(x,y) is the spatial distribution of illumination and ri(x,y), the distribution of scene reflectance's. The convolution with surround function works as averaging in the neighborhood. So that

$$R_i(x,y) = \log \frac{S_i(x,y) r_i(x,y)}{\overline{\overline{S_i(x,y)}}\,\overline{\overline{r_i(x,y)}}} \quad (4)$$

Generally the illumination has slow spatial variation, which means

$$S_i(x,y) \approx \overline{S_i(x,y)} \quad (5)$$

Then it will be apparent that color constancy (i.e., independence from source illumination spectral and spatial variation) is achieved.

$$R_i(x,y) \approx \log \frac{r_i(x,y)}{\overline{\overline{r_i(x,y)}}} \quad (6)$$

Various surround function could be used. Land proposed an inverse square spatial surround function,

$$F(x,y) = 1/r^2 \quad (7)$$

Moore suggested the exponential formula with absolute parameter,

$$F(x,y) = \exp(-r/c) \quad (8)$$

And Hurlbert studied the Gaussian,

$$F(x,y) = K \exp(-r^2/c^2) \quad (9)$$

Jobson stated that Gaussian had the property of being more "regional" and offered good dynamic range compression over a large range of space constant. The selection of space constant is related with visual angel in the direct observation. But the value cannot be theoretically modeled and determined. Basically there is a trade-off between dynamic compression, (for example, details in the shadow), and color rendition. The middle of the range between 50 and 100 pixels represents a reasonable compromise.

b. Multiscale Retinex (MSR)

Because of the tradeoff between dynamic range compression and color rendition, we have to choose a good scale c in the formula of F(x, y) in SSR. If we do not want to sacrifice either dynamic range compression or color rendition, multiscale retinex, which is a combination of weighted different scale of SSR, is a good solution,

$$R_{MSRi} = \sum_{n=1}^{N} \omega_n R_{ni} \quad (10)$$

Where N is the number of the scales, Rni is the ith component of the nth scale. The obvious question about MSR is the number of scales needed, scale values, and weight values. Experiments showed that three scales are enough for most of the images, and the weights can be equal. Generally fixed scales of 15, 80 and 250 can be used, or scales of fixed portion of image size can be used. But these are more experimental than theoretical, because we do not know the scale of image to the real scenes. The weights can be adjusted to weight more on dynamic range compression or color rendition

c. Color restoration method for MSR (MSRCR)

MSR is good for gray images. But it could be a problem for the color images because it does not consider the relative intensity of color bands. This can be seen from formula of MSR, whose output is the relative reflectances in the special domain. Considering the images "out of gray world", whose average intensity for three color band are far from equal, the output of MSR for three channels will be more close, which make it looks more gray. The solution to this problem is to introduce weights for three color channels depending on the relative intensity of the three channels in the original images.

$$C_i(x,y) = f[I_i'(x,y)] \quad (11)$$

Where the relative intensity of three channels

$$I_i'(x,y) = I_i(x,y) / \sum_{i=1}^{S} I_i(x,y) \quad (12)$$

The color restoration function should be monotonic. Several linear and nonlinear functions were tried, Jobson found the best overall color restoration was

$$C_i(x,y) = \beta \log[\alpha I_i'(x,y)] \quad (13)$$

This color restoration method can be described as,

$$R_{MSRCR_i}(x,y) = C_i(x,y) R_{MSR_i}(x,y) \quad (14)$$

d. MSRCR with gain/offset

Generally the output after MSRCR processing will be out of the display domain. It needs to be shifted and compressed to the display domain. People used the auto gain/offset method, where the gain and offset are based on the specified image statistics. But research showed that the histograms of different images got typical shape and position, which means the gain and offset parameters could be set once and run forever.

Module 3: Partitioning and mapping:

Image partitioning [3] can be a useful tool in facing image degradation. In image segmentation the input is a set of pixels with given grey levels and the output is a partition of the set of pixels into connected regions ("classes"), so that a given set of requirements on the single classes and on adjacent classes is satisfied (i.e. pixels belonging to the same class must have approximately the same grey levels or the same textures and pixels belonging to adjacent classes must have significantly different grey levels or different textures). Once segmentation has been performed, the same grey level is associated with each pixel of the same class. The grey level can either be related to the original grey levels of the class, or can be given by a new grey scale on the ground of contrast optimization criteria. The segmentation technique proposed in this presentation is a method for finding the most homogeneous classes and the best possible contrast in a row by row image processing. In partitioning each row of the image, we have two aims: the partition must be as good as possible in its own right, and it must be as compatible as possible with the partitions of the other rows. If we take into account the two aims simultaneously, then the solution procedure becomes complex. To simplify and speed-up the procedure, we can partition each row independently, and then we can apply region merging techniques to the resulting set of row partitions. In the presentation the problem is formulated as a path partitioning one and a simple O(n p) row-partitioning algorithm based on a shortest path formulation of the problem is given.

Module 4: Enhancing the image to colored image and the histogram generation:

After partitioning mapping is done, in which the image is mapped to X-Y co-ordinate and it is compared with the original image histogram. When partitioning is over, the image is extended to the colored image, and its histogram is generated. The histogram of enhanced colored image gives better results than the original image histogram. At the last we will get the enhanced image which is having better quality than the original image.

Module 5: Histogram comparison and its analysis:

In this module we compare the histogram of original image with the histogram of the enhanced colored image. The histogram having greater quality can be considered as a result of enhanced image result.

III. Related Work

It uses Gaussian mixture model to model the image gray-level distribution, and the intersection points of the Gaussian components in the model are used to partition the dynamic range of the image into input gray-level intervals [1].

It describes Retinex image enhancement technique in detail[2].It gives approach of hypothesis selection filter for image enhancement[4].It propose novel and effective two-stage enhancement scheme in both the spatial domain and the frequency domain by learning from underlying images.It first enhance the fingerprint image in the spatial domain with a spatial ridge-compensation filter by learning from the image and with the help of first stage the second stage filter is employed[5].Description of histogram technique is present in book mentioned in reference [6].

IV. Experimental Setup

In proposed system, we initially tried an implementation of histogram technique which first loads the image and then generates the histogram of the original image. Once histogram of the image is generated, then retinex modeling technique will be applied on it. It will result an enhanced image.

After that we will generate a histogram for this enhanced image and we will compare it with original one. The result of comparison of both histograms will prove the enhancement. It is used c#.net for generating the histogram.

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V. Experimental Result

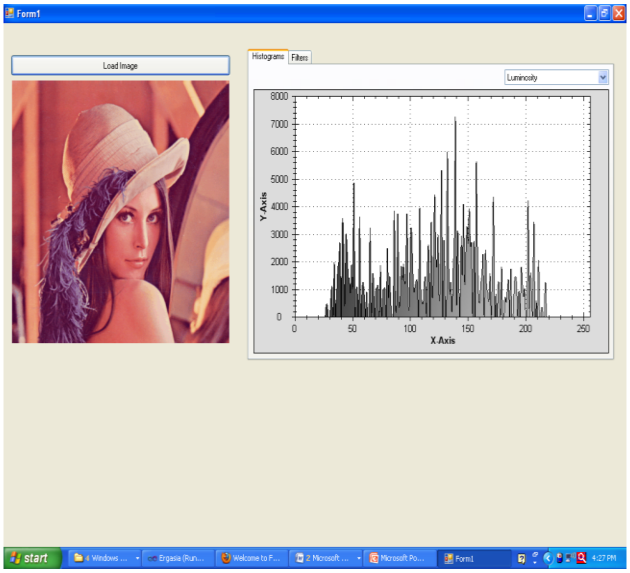

Fig 2: Generated histogram for sample image.

As shown in the fig 2, it first loads a sample image. After loading an image it will generate a histogram of that image.

VI. Conclusion and Future Work

First literature survey is carried out on image processing techniques. Then we identified the need to enhance the images for better visualization. Then we proposed "Automatic image enhancement for better visualization using retinex technique". We have implemented code for generating histogram of sample image.

Our future work will attempt to implement the remaining system.

References

[1] Turgay Celik and Tardi Tjahjadi," Automic image equalization and contrast enhancement using Gaussian Mixture Modeling", senior member, IEEE.

[2] Zhixi Bian and Yan Zhang,"Retinex Image Enhancement Techniques—Algorithm, Application and Advantages"

[3] Mario Lucertini Yehoshua Perl ,Bruno Simeone," Image enhancement by path partitioning".

[4] Tak-Shing, Charles A. Bouman, Ilya Pollak,"Image Enhancement using Hypothesis selection Filter: Theory and application to JPEG decoding"

[5] Jucheng Yang ,Naixue Xiong,Athanasios V. Vasilakos,"Two stage enhancement scheme for low-quality fingerprint images by learning from images", Member IEEE.

[6] Online Available: https://skydrive.live.com

[7] Online Available: http://www.google.co.in/

[8] A.K.Jain,"Fundamentals of Digital image processing", a book.

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